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For: INTERFACE DEVICE WITH ELECTRICAL ENERGY GENERATOR

CLAIM OF PRIORITY

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In accordance with the provisions of 35 U.S.C. 119, Applicant hereby claims the priority of German Patent Application No. 102 60 924.1 filed December 20, 2002. The certified copy is submitted herewith.

Respectfully submitted,

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Prioritätsbescheinigung über die Einreichung einer Patentanmeldung

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Palo Alto, Calif./US

Bezeichnung: Interface device with electrical energy generator

IPC: noch nicht festgelegt

Die angehefteten Stücke sind eine richtige und genaue Wiedergabe der ursprünglichen Unterlagen dieser Patentanmeldung.

München, den 12. Februar 2003
Deutsches Patent- und Markenamt
Der Präsident

Im Auftrag

A handwritten signature in black ink, consisting of a stylized 'H' followed by a long horizontal stroke.

Hoß

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Interface device with electrical energy generator

Description

Field of the invention

The present invention relates generally to interface devices for allowing humans
5 to interface with computer systems, and more particularly to mechanical
computer interface devices that allow the user to provide input to computer
systems.

Background and Prior Art

Computer systems are used extensively in many different industries and for private applications. Typically, users can interact with a visual environment displayed by a computer on a display device to perform functions on the computer, play a game, experience a simulation or "virtual reality" environment, use a computer aided design (CAD) system, browse the World Wide Web, or otherwise influence events or images depicted on the screen.

One visual environment that is particularly common is a graphical user interface (GUI). GUI's present visual images, which describe various graphical metaphors of a program or operating system implemented on the computer. Common GUI's include the Windows® operating system from Microsoft Corporation, the MacOS® operating system from Apple Computer, Inc., and the X-Windows GUI for Unix operating systems. The user typically moves a user-controlled graphical object, such as a cursor or pointer, across a computer screen and onto other displayed graphical objects or screen regions, and then inputs a command to execute a given selection or operation.

Other programs or environments also may provide user-controlled graphical objects such as a cursor and include browsers and other programs displaying graphical "web pages" or other environments offered on the World Wide Web of the Internet, CAD programs, video games, virtual reality simulations, etc. In some graphical computer environments, the user may provide input to control a 3-D "view" of the graphical environment, as in CAD or 3-D virtual reality applications.

The user interaction with and manipulation of the computer environment is achieved using any of a variety of types of human-computer interface devices that are connected to the computer system controlling the displayed environment. A common interface device for GUI's is a mouse or trackball. A mouse is moved by a user in a planar workspace to move a graphical object such as a cursor on the 2-dimensional display screen in a direct mapping

between the position of the user manipulandum and the position of the cursor. This is typically known as "position control", where the motion of the graphical object directly correlates to motion of the user manipulandum.

5 To allow the user easier control of scrolling, zooming, and other like functions when using a mouse, a "scroll wheel" or "mouse wheel" has been developed and has become quite common on computer mice. A mouse wheel is a small finger wheel provided on a convenient place on the mouse, such as between two mouse buttons, which the user may rotate to control a scrolling or zooming function. Most commonly, a portion of the wheel protrudes out of the top surface
10 of the mouse which the user can move his or her finger over.

The wheel typically includes a rubber or other frictional surface to allow a user's finger to easily rotate the wheel. In addition, some mice provide a "clicking" wheel that moves between evenly spaced physical detent positions and
15 provides discrete positions to which the wheel can be moved as well as providing the user with some physical feedback as to how far the wheel has rotated. The wheel is most commonly used to scroll a document in a text window without having to use a scroll bar, or to zoom a window's display in or out without selecting a separate zoom control. The wheel may also be used in
20 other applications, such as a game, drawing program, or simulation.

Usually the wheel has a frictional feel to it. For example, some mouse wheels have physical detents, which are spaced a constant distance apart and have a tactile response when a scrolling or zooming task is performed or the
25 characteristics of a document or view are manipulated.

Conventionally, a computer mouse is connected to a computer system by a cable for transmitting signal/power there between. For example, such a computer mouse is known from US Patent No. 5,912,661. The cable, however,
30 may hinder efficient and unobstructed movement of the mouse causing inconvenience to a user. A cable-less mouse that communicates with a

computer system by means of electromagnetic signals for data transmission overcomes the problem. However, since no cable connects between the mouse and the computer system, the mouse has to incorporate an independent power source therein for powering itself.

5 US Patent No. 6,411,279 shows a cable-less mouse power saving device. The microprocessor of a computer mouse may force the mouse into an idle condition for reducing power consumption after having not received a control signal for a predetermined period of time.

10 The invention aims to provide an improved interface device, computer system and method for recharging a battery of the interface device and/or computer system.

Summary of the invention

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The present invention provides for an interface device, such as a computer mouse, track ball or joystick, for interfacing a user's input with a computer. In essence, the invention enables to generate electrical energy from mechanical energy applied by the user when a mechanical input operation is performed.

20 The electrical energy is used to recharge a battery of the interface device and/or of the computer system. This way the time intervals for connecting the batteries to an external power source for recharging are extended. In some applications it is even possible to completely abolish the requirement for recharging the batteries by means of an external power source as the electrical energy, which
25 is generated from the mechanical input energy is sufficient for powering the interface device and/or the computer system.

The present invention is particularly advantageous for cordless computer mice. Such cordless computer mice to-date typically have non rechargeable batteries
30 which need to be replaced from time to time when the batter capacitance is exhausted. In accordance with the present invention, a rechargeable batter is

used which is recharged by electric energy, which is generated from the user input actions. This way the time intervals for exchanging the battery are extended or the computer mouse can even become an autonomous system as far as power supply is concerned. In this case replacing the battery is no longer
5 necessary as the electrical energy which is generated from the mechanical user input actions is sufficient to power the system. This is particularly advantageous in order to avoid downtimes of the computer system and to minimise maintenance requirements for the computer system.

10 In accordance with a further preferred embodiment of the invention, the computer mouse is connected to the computer system by a cable. The cable serves to transmit both input signals and electrical energy being generated from the mechanical user input actions to the computer system. The electrical energy supplied from the computer mouse to the computer system is used to recharge the batteries of the computer system. This is particularly
15 advantageous for laptop computers or other mobile computing devices, such as Palm Top Computers and Personal Digital Assistants.

20 In accordance with a further preferred embodiment of the invention the interface device is integrated into the housing of the computer itself. This is particularly advantageous for interface devices like track balls or wheels, which are integrated into the housing of a laptop computer or other mobile computing device.

25 In accordance with a further preferred embodiment of the invention a wheel that is rotatably mounted on an axle is rotated by a digit of the user in order to perform an input operation. The axle is coupled to electrical energy generator means for the generation of electrical energy when the wheel is rotated. The electrical energy generator is coupled to the battery for recharging.

30 In accordance with a further preferred embodiment of the invention, the electrical energy generator is an electro magnetic device having a step motor winding configuration. This way a pre-defined step angle is provided of the rotation of the wheel. When the user rotates the wheel by a number of step

angles a corresponding number of electrical energy pulses is generated from the step motor winding configuration. This is particularly advantageous as the generator has a double function: it is both used to generate the electrical energy as well as for providing a segmented feel to the rotation of the wheel. In particular this has the advantage that a separate dent mechanism is not required. Further, the generator with the step motor winding configuration can also be used for determining the amount of angular movement of the wheel on the basis of the electrical energy pulses which are generated when the wheel is rotated by a user.

10 In accordance with a further preferred embodiment of the invention a battery type is used which can be pulse-charged. This has the advantage that the electrical energy pulses, which are generated by the step motor winding configuration, can be directly applied to the battery without filtering. Examples for such batteries, which can be pulse charged, are nickle-cadmium and nickle-metal-hydride batteries. Especially when Lithium-Ion batteries are used, it is preferred to apply a smoothening filter to the electrical energy pulses before application to the Lithium-Ion battery in order to prevent damage from the battery.

20 In accordance with a further preferred embodiment of the invention the movement of the mouse ball is used for generating electric energy for recharging the batteries. For example, the mouse ball can contain magnetic particles which create a static electro-magnetic field surrounding the mouse ball. When the mouse ball is rolled on a planar workspace a voltage is induced by the moving electro-magnetic field into a winding which serves as a generator. The same principle for generating of electric energy can also be implemented for a track ball.

Brief description of the drawings

30 In the following preferred embodiment of the present invention will be described in greater detail by making reference to the drawings in which:

Figure 1 is a perspective view of the exterior of a cordless interface device incorporating an electrical generator in accordance with the principles of the present invention,

5 Figure 2 is a block diagram of the cordless interface device having a rechargeable battery,

Figure 3 is a plan view of certain components of the interface device of figures 1 and 2 with the top of the housing and the associated buttons removed,

10 Figure 4 is a block diagram of a mobile computer having rechargeable batteries and being connected to an interface device by means of a cable,

Figure 5 is a block diagram of a cordless interface device where the generator serves to detect the amount of angular movement,

15 Figure 6 is a block diagram of a mobile computer having an integrated interface device,

Figure 7 is illustrative of a flow diagram for performing a preferred embodiment of the method of the invention.

Detailed description

20 With reference to figures 1 to 3, an embodiment of the present invention is illustrated in a computer mouse. As seen in figure. 1, a mouse 104 has a plastic housing with an outer surface 105 including an upper surface 107. Left and right mouse buttons 109 and 111 are located on the upper surface 107. A rim or edge of a rotatable wheel 112 protrudes from the upper surface 107 through a space between the left and right mouse buttons 109 and 111. The
25 surface of the mouse buttons are recessed somewhat in the vicinity of the wheel button.

While the present invention is shown for illustration purposes within a mouse, it will be understood that the upper surface 107 shown in FIG. 1 may also be a surface of a trackball or other input device, and may be disposed other than horizontally, and may vary in other ways from the particular embodiment shown.

5

Figure 2 shows a computer system 100 comprising a computer 102 to which the computer mouse 104 is coupled. Computer 102 can be a personal computer having a processor 106. A receiver 108 is connected to computer 102 by cable 110. Receiver 108 serves to receive electro-magnetic or optical signals from cordless computer mouse 104. Wheel 112 of mouse 104 is rotatable about wheel axle 114. Wheel 112 is arranged such that it is rotatable by a digit of a user in order to perform an input operation.

10

A rotation of the wheel 112 is sensed by sensor 116. Sensor 116 can be of a mechanical or optical type and detects a rotation movement of wheel 112. The corresponding signal being representative of an angular movement of the wheel 112 is provided from sensor 116 to processor 118 of mouse 104. Processor 118 encodes the signal provided by sensor 116 and provides the encoded signal to transmitter 120. Transmitter 120 sends the encoded signal to receiver 108 of computer 102 for input into processor 106.

15

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A generator 122 is mechanically connected to wheel axle 114. When the wheel 112 is rotated by a digit of the user the corresponding torque is transmitted by means of wheel axle 114 to generator 122. This torque drives generator 122 such that the mechanical energy is transformed into electrical energy. This electrical energy is used for recharging battery 124 of mouse 104. Battery 124 provides power for operation of the cordless mouse 104, in particular to processor 118 and transmitter 120. Depending on the type of rechargeable battery 124, which is used the electrical energy may either be applied directly or indirectly via a smoothening filter 126 to battery 124.

25

If battery 124 is a nickle-cadmium-cell or a nickle-metal-hydrate-cell pulses of electrical energy are preferred for recharging. In this instance filter 126 may not

30

be required. However, if battery 124 is a lithium-ion cell smoothing filter 126 may be required in order to prevent damage from battery 124.

It is preferred that generator 122 has a step motor winding configuration. In fact generator 122 can be realised by means of a step motor, which is used as a
 5 generator rather than as a motor. Any type of step motor can be used for this purpose, such as variable reluctance, permanent magnet and hybrid step motors.

The step motor winding configuration provides for a certain step angle. For example the step angle can be between 0.9° and 3.6°.

10 It is particularly advantageous to use a generator 122 having a step motor winding configuration in combination with a battery 124, which requires pulse charging. In this instance the energy pulses provided by generator 122 can be directly used for recharging battery 124 without filtering.

15 In operation, when a user desires to perform an input operation, the user places his or her digit on wheel 112 and rotates the wheel in order to perform a scrolling or zooming operation or the like. The user rotates the wheel 112 by an angular displacement which corresponds to the desired input operation. This angular movement is detected by sensor 116. At the same time the rotation of the wheel axle 114 which is due to the angular movement of wheel 112 is used
 20 to drive generator 122 which in response generates electrical energy for recharging of the battery 124. Battery 124 powers processor 118 which encodes the signal delivered by sensor 116 as well as transmitter 120 which transmits the encoded signal to receiver 108 of computer 102.

Figure 3 shows a top view of mouse 104 with the top of the housing removed.
 25 The bottom of the housing has an opening 128 for receiving a ball 130. In addition or as an alternative a mechanical movement of ball 130 can be used for generating electrical energy. For this purpose ball 130 contains magnetic particles which form a resulting static magnetic field surrounding ball 130. Further a cylinder coil is disposed in opening 128 which surrounds ball 130.

When ball 130 is rolled the moving magnetic field induces a voltage in the coil. The coil is connected to battery 124 such that battery 124 is recharged.

Figure 4 shows an alternative embodiment of a computer system 200. Like elements of the embodiment of figure 4 are designated with like reference numerals as in figures 1,2 and 3 having added 100.

Mouse 204 is not a cable-less mouse as mouse 104 of figure 1, 2 and 3, but is connected to computer 202 by means of cable 226. By means of the cable 226, processor 218 and processor 206 are coupled such that processor 218 can output the encoded signal provided by sensor 216 as an input signal to processor 206. Likewise generator 224 is coupled to battery 224 of computer 202 via cable 226. Battery 224 powers computer 202, in particular processor 206 as well as mouse 204, in particular processor 218. Battery 224 is recharged when a user performs an input action by rotating wheel 212 in accordance with the same principles as explained with respect to figures 1, 2 and 3 rotating the wheel 212 by the user drives the generator 222 via wheel axle 214, such that electrical energy is generated by generator 222, which is transmitted to battery 224 for recharging.

Preferably computer 202 is a mobile computer, such as a laptop computer, palm top computer or personal digital assistant. The time intervals between recharging battery 224 by means of an external power source can be extended by recharging battery 224 by means of the energy supplied by generator 222. If power consumption of computer 202 is relatively low, such an external power source may even become completely obsolete for the operation of the computer system 200.

Figure 5 shows a block diagram of a variant of the embodiment of figure 4. Again, like elements of figure 5 are designated with like reference numbers having added 100.

In contrast to the computer system 200, the computer system 300 of figure 5 has no sensor for directly sensing an angular movement of the wheel 312.

Rather there is sensor 328, which senses the voltage pulses which are generated by generator 322. Generator 322 has a step motor winding configuration such that the number of output pulses is representative of the distance of the angular movement of wheel 312. These output pulses are sensed by means of sensor 328 and inputted into processor 318. Processor 318 encodes the sensed voltage pulses and provides a corresponding input signal to processor 306. Still the output pulses generated by generator 322 are supplied to batter 324 for recharging.

Figure 6 shows a block diagram of a mobile computer 400, such as a laptop computer. Computer 400 has rechargeable battery 424. Computer 400 has a housing, which carries wheel axle 414 of wheel 412. In other words, there is no separate hardware unit to provide a mechanical input device but the mechanical input device is integrated into the housing of the computer. The computer housing has an opening through which a portion of wheel 412 protrudes such that a user can rotate wheel 412 by his or her digit. Rotation of the wheel 412 is sensed by sensor 416 and the sensed motion is inputted into processor 418. As in the embodiments of figures 1, 2, 3, 4 and 5 the mechanical energy which is provided by the user by rotating the wheel 412 is converted by generator 422 into voltage pulses which are applied to battery 424 for the purpose of recharging.

This way the time intervals between connecting computer 400 to an external power source can be extended. When computer 400 has a low power consumption, such as in the case of palm top or personal digital assistant computers, connecting the computer 400 to an external power source may even become superfluous as the electrical energy which is generated from the mechanical input energy is sufficient to sustain operation of the system.

Figure 7 shows a flow chart being illustrative of an embodiment of the method of the invention. In step 500 the moveable mechanical element of a mechanical input device, such as a wheel, is rotated by a certain step angle. Due to the rotation a pulse is generated in step 502 by a generator. This pulse is used in

step 504 for recharging the battery of the mechanical input device or of the computer itself.

In parallel to steps 502 and 504, steps 506 and 508 are performed: in step 506 the rotation of the wheel is sensed and encoded. The encoded amount of rotational movement of the wheel is inputted into a processor in step 508 as an input signal.

list of reference numerals

5	100	computer system
	102	computer
	104	mouse
	105	outer surface
	106	processor
10	107	upper surface
	108	receiver
	109	mouse button
	110	cable
	111	mouse button
15	112	wheel
	114	wheel axle
	116	sensor
	118	processor
	120	transmitter
20	122	generator
	124	battery
	126	smoothing filter
	128	opening
	130	ball
25	200	computer system
	202	computer
	204	mouse
	206	processor
	212	wheel
30	214	wheel axle
	216	sensor
	218	processor
	222	generator

	224	battery
	226	cable
	300	computer system
	302	computer
5	304	mouse
	306	processor
	312	wheel
	314	wheel axle
	318	processor
10	322	generator
	324	battery
	326	cable
	328	sensor
	400	computer
15	412	wheel
	414	sensor
	422	generator
	418	processor
	424	battery

c l a i m s

1. An interface device for interfacing a user's input with a computer (102; 202; 302; 400), the interface device comprising:
- 5
- mechanical input means or transforming a mechanical input operation of the user to an input signal for input into the computer, the mechanical input means having at least one movable element (112; 212; 312; 412) being adapted to be moved by the user to perform the input operation,
 - electrical generator means (122; 222; 322; 422) being mechanically coupled to the moveable element to generate electrical energy when the input operation is performed,
 - means for electrically coupling the generator means to rechargeable battery means (124; 224; 324; 424) for recharging the battery means with the electrical energy.
- 10
- 15
2. The interface device of claim 1, the movable element being a wheel (112; 212; 312; 412), the wheel being rotatable about a wheel axle (114; 214; 314; 414) by a digit of the user, and the generator means being mechanically coupled to the wheel axle.
- 20
3. The interface device of claim 1, the movable element being a ball which is disposed in a housing for rolling on a planar workspace.
4. The interface device of claim 1, the movable element being a ball, the ball being disposed in a housing of the computer for rolling by a digit of the user.
- 25
5. The interface device of claims 3 or 4, the ball being magnetized and the generator means comprising a winding into which a voltage is induced when the ball is rolled.

6. The interface device of claims 1 or 2, the generator means being an electro-magnetic device for converting a rotation of the wheel axle for a pre-defined step angle into a pulse of the electrical energy.

5 7. The interface device anyone of the preceding claims 1 to 6 the generator means having a step motor winding configuration.

8. The interface device of anyone of the preceding claims 1 to 7 the battery means being adapted for pulse charging with the pulses of electrical energy.

10 9. The interface device of claims 6, 7 or 8, further comprising a filter (126) for smoothening the pulses of the electrical energy before application to the battery means.

15 10. The interface device of any one of the preceding claims 1 to 9, further comprising a user manipulandum being moveable in two degrees of freedom in a planar workspace with respects to a ground surface, the user manipulandum carrying at least the mechanical input means and the electrical energy generator means.

11. The interface device of claim 10, the user manipupandum carrying the battery means and means (120) for wireless transmission of the input signal to the computer.

20 12. The interface device of claim 10, the user manipulandum having a cable (226; 326) for transmitting the input signal and the electrical energy to the computer.

13. The interface device of any one of the preceding claims 1 to 12, the mechanical input means being integrated into a housing of the computer.

25 14. A computer system comprising:

- processor means (106; 206; 306; 418),

- mechanical input means for transforming a mechanical input operation of a user to an input signal for the processor means, the mechanical input means having at least one movable element (112; 212; 312; 412) being adapted to be moved by the user to perform the input operation,
- 5 - electrical energy generator means (122; 222; 322; 422) being mechanically coupled to the moveable element to generate electrical energy when the input operation is performed,
- 10 - rechargeable battery means (124; 224; 324; 424) being electrically coupled to the generator means for recharging by the electrical energy.

15. The computer system of claim 14, the moveable element being rotatably attached to a housing of the computer system.

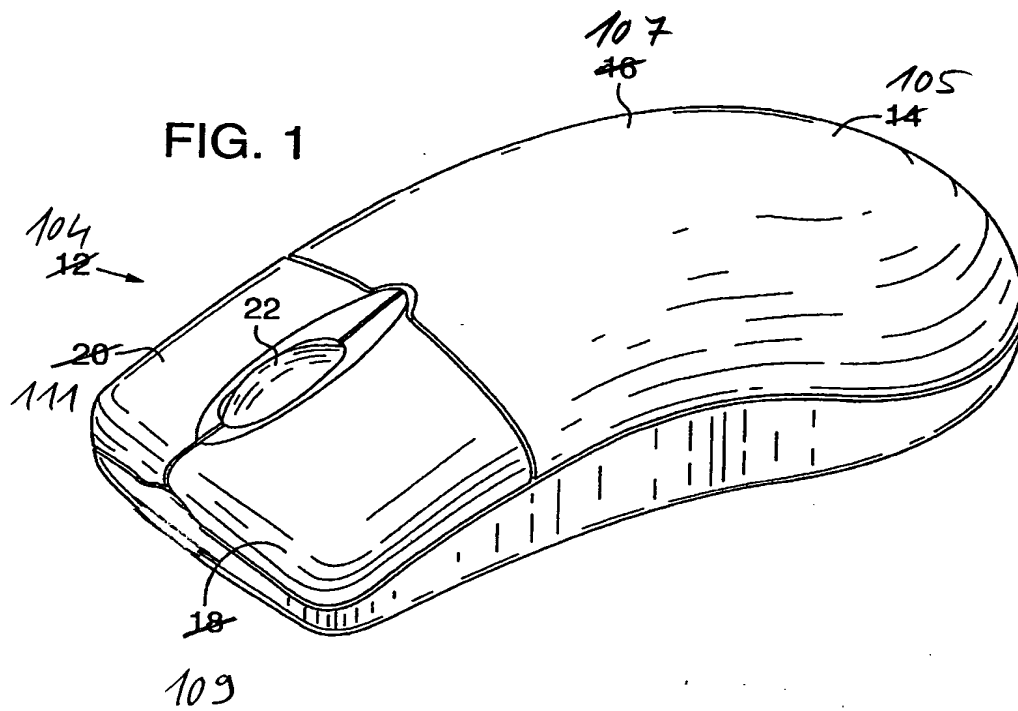
16. A method for recharging a battery, the method comprising the steps of:

- 15 - performing a mechanical input operation by applying mechanical energy onto a moveable element such that the moveable element is moved by a distance,
- 20 - generating an input signal for the computer in response to the movement of the moveable element,
- 20 - transforming of the movement of the moveable element into electrical energy,
- recharging of the battery by means of the electrical energy.

17. The method of claim 16, whereby the mechanical input operation is performed by rotating of a wheel about a wheel axle to which an electrical energy generator is coupled.

18. The method of claim 17, whereby the rotation of the wheel is performed in pre-defined step angles and a pulse of electrical energy is generated for each step angle of rotation.
19. The method of claim 18, further comprising smoothening of the pulses before application to the battery means.
20. The method of claim 16, whereby the mechanical input operation is performed by rolling of a ball on a planar workspace.
21. A cordless computer mouse including a battery connected to a transducer for transducing kinetic energy of a manually operable actuator within the mouse into electrical energy.
22. A mouse according to claim 21 wherein the actuator includes a ball in the mouse which rotates when the mouse is translated.
23. A mouse according to claim 21 wherein the actuator includes a wheel in the mouse rotated to navigate a user interface on a computer to which the mouse is connected.

FIG. 1



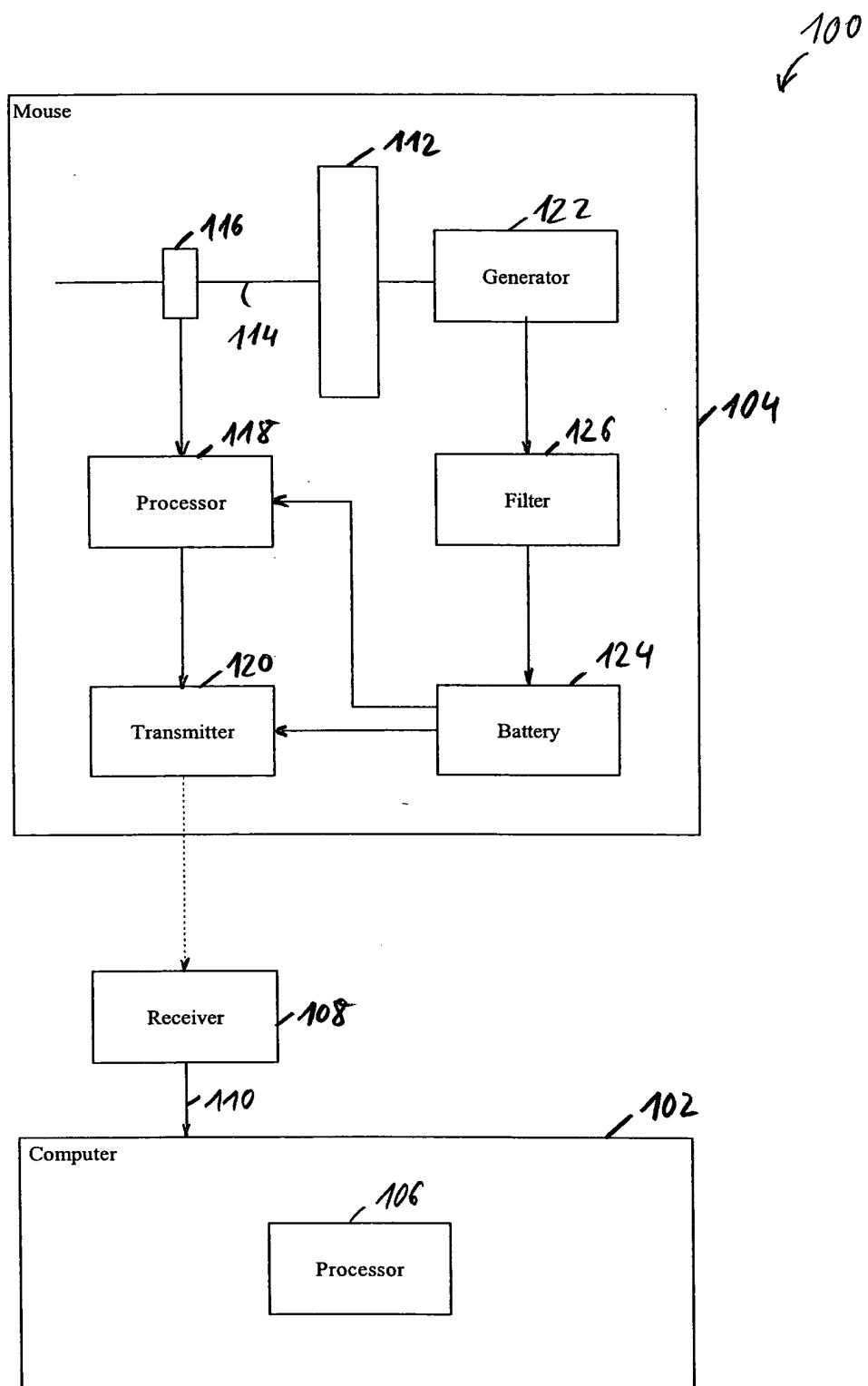


Fig. 2

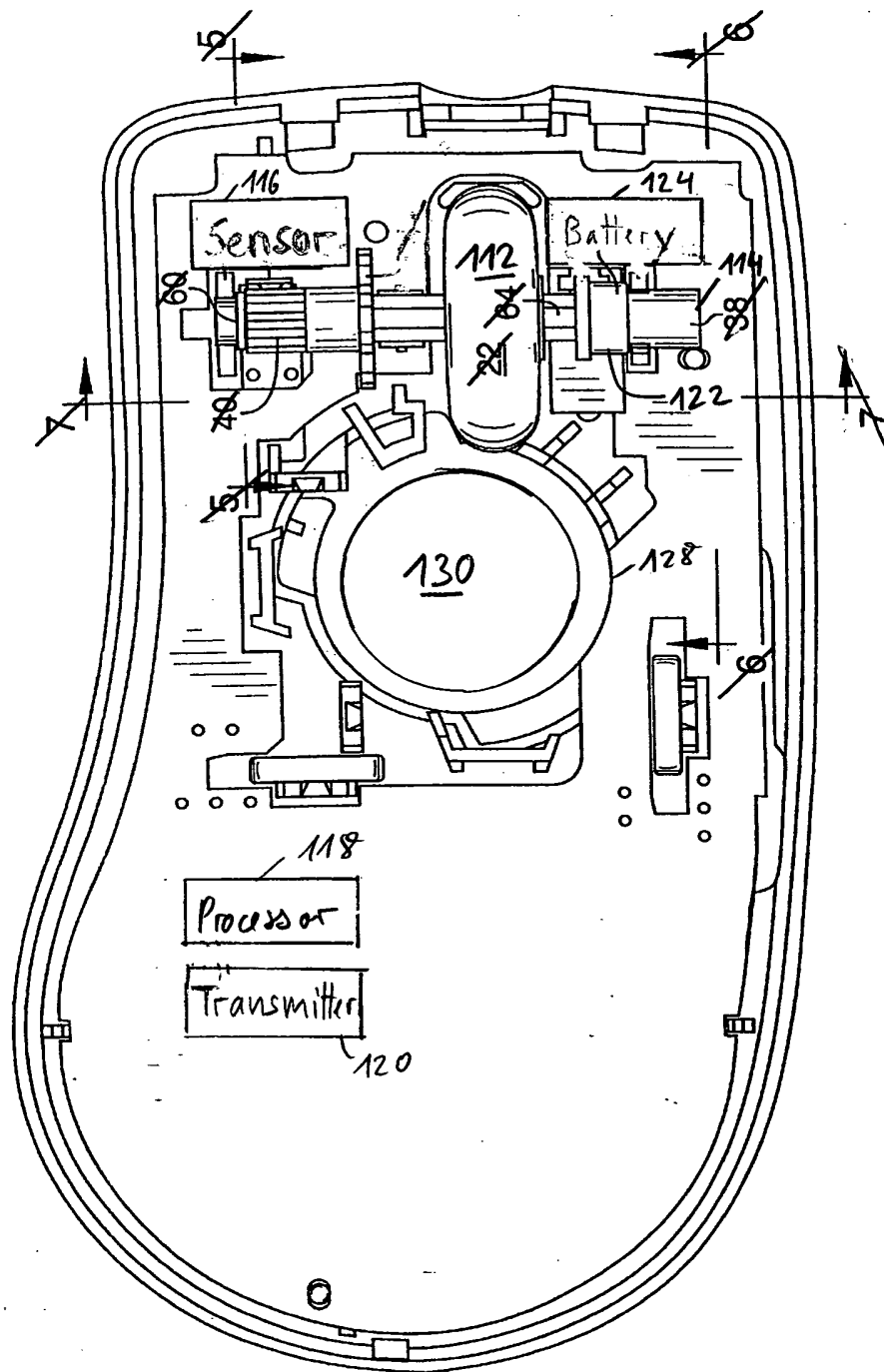


Fig. 3

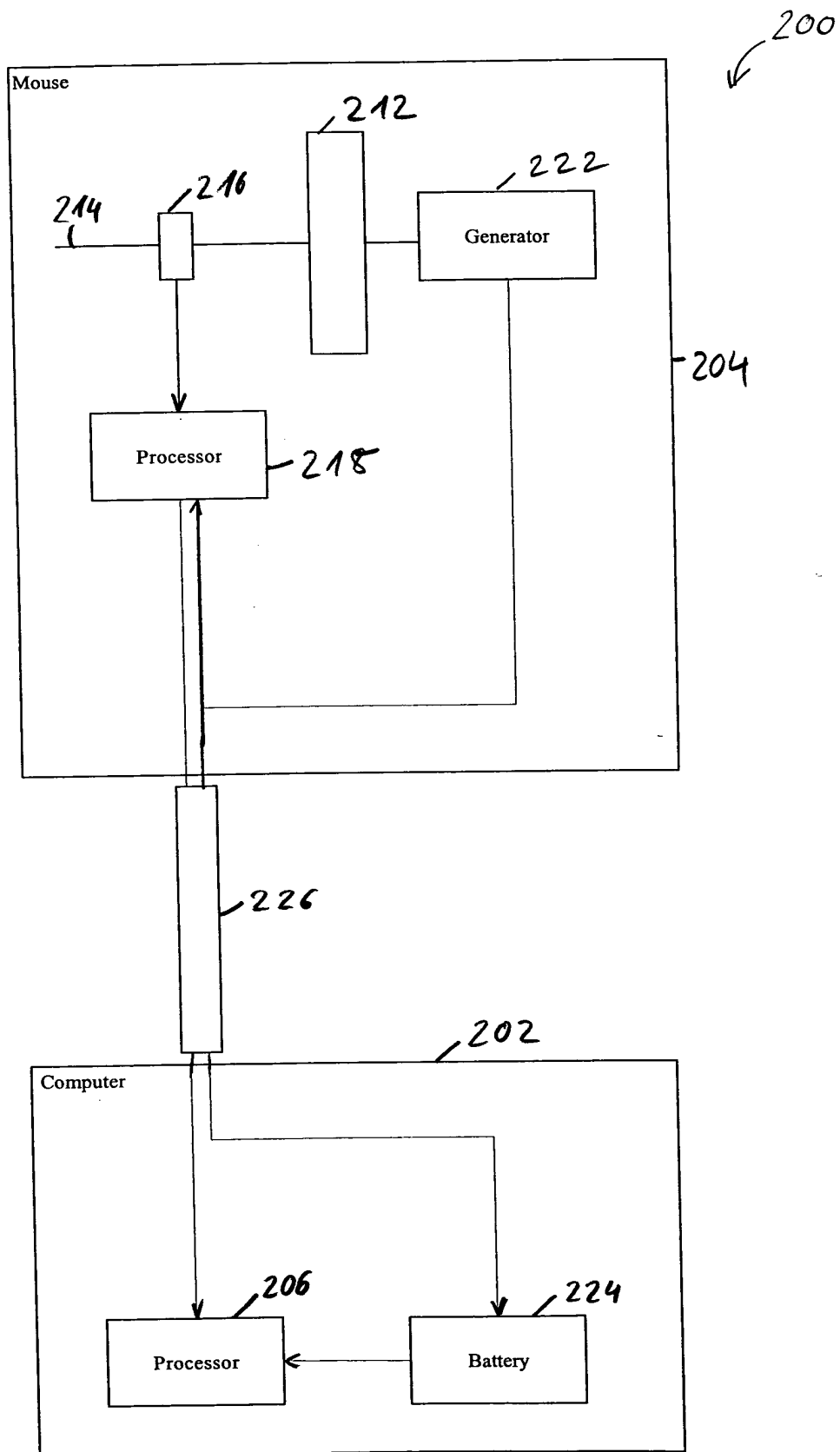


Fig. 74

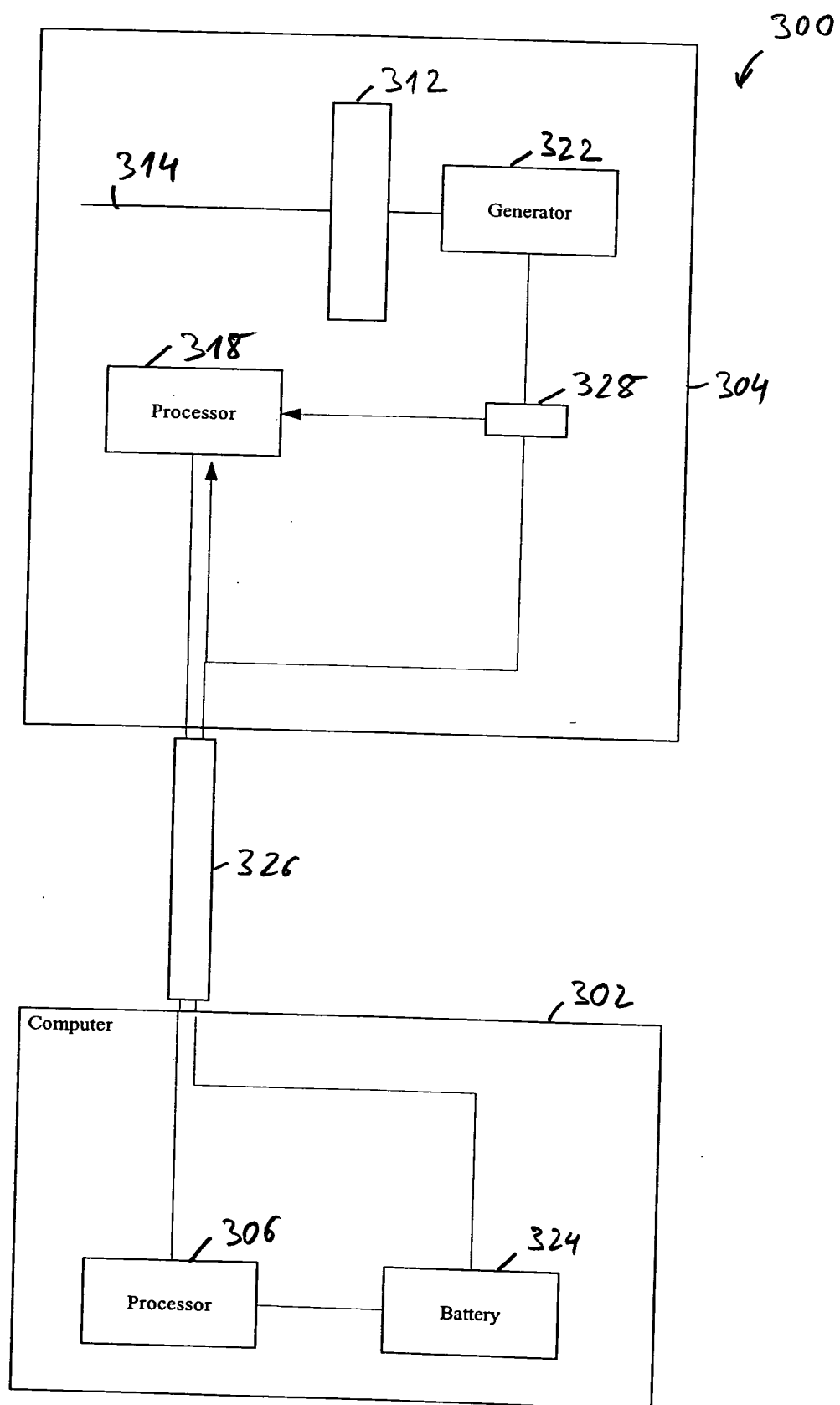


Fig. 5

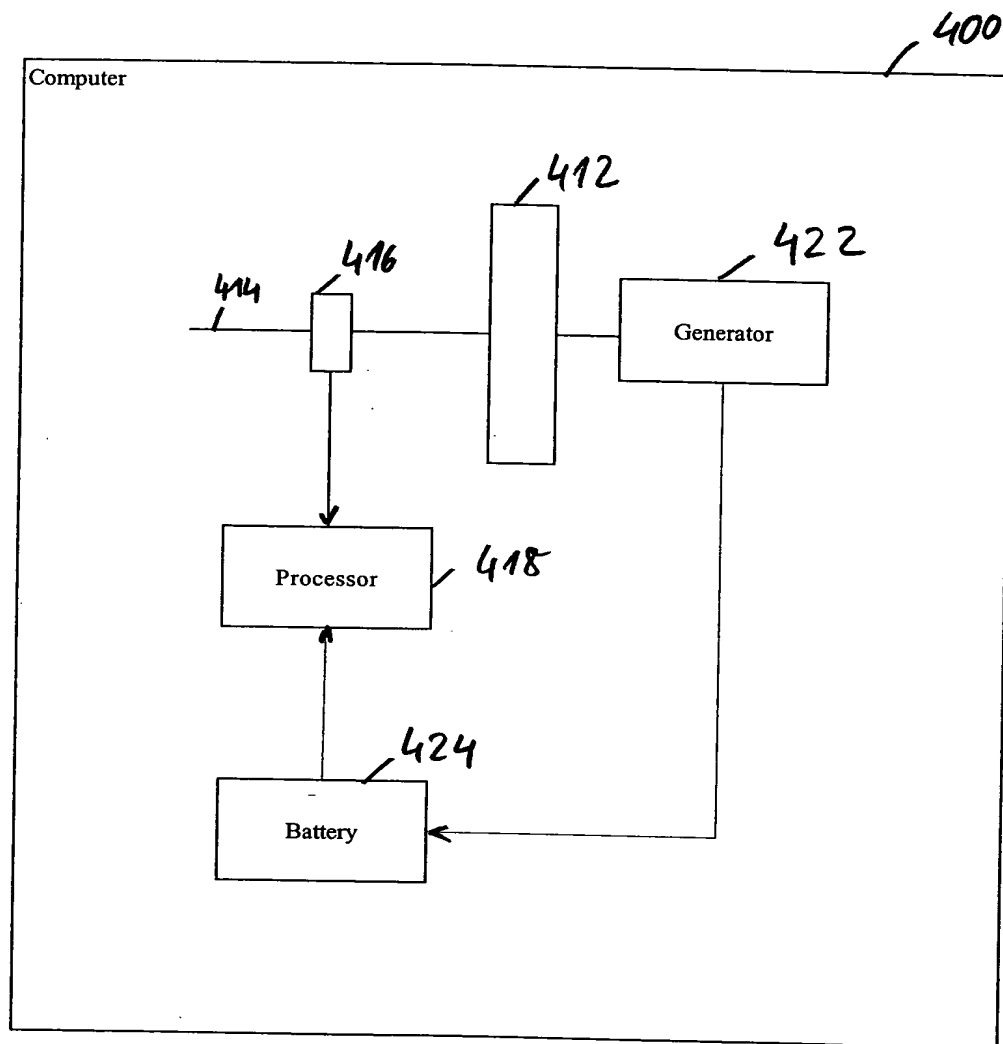


Fig. 6

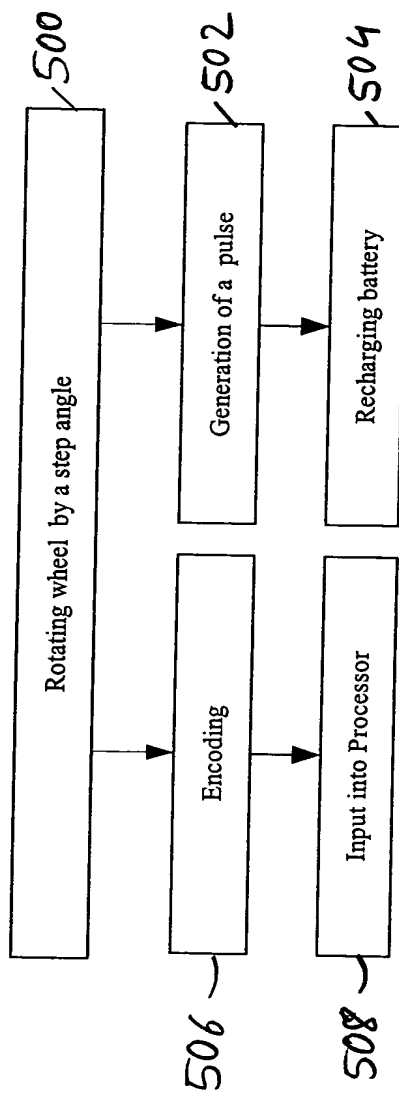


Fig. 7

Abstract

Interface device with electrical energy generator

5 This invention relates to An interface device for interfacing a user's input with a computer (102; 202; 302; 400), the interface device comprising:

- 10 - mechanical input means or transforming a mechanical input operation of the user to an input signal for input into the computer, the mechanical input means having at least one movable element (112; 212; 312; 412) being adapted to be moved by the user to perform the input operation,
- electrical generator means (122; 222; 322; 422) being mechanically coupled to the moveable element to generate electrical energy when the input operation is performed,
- 15 - means for electrically coupling the generator means to rechargeable battery means (124; 224; 324; 424) for recharging the battery means with the electrical energy.

(Figure 1)

FIG. 1

